TROUT FARMING IN MANITOBA

Manitoba
Conservation
Fisheries

INTRODUCTION

Fish farming (or aquaculture) has been practised in Manitoba since the late 1960s. It began with experimental studies on "pothole" lakes in the Erickson area in southwestern Manitoba. There are numerous small highly productive waterbodies in the province that are not capable of supporting fish on a year-round basis. Their shallow depth and our severe winter climate often combine to produce dissolved oxygen levels too low to sustain fish life during the winter months.

Some of these waters have been found to be satisfactory for fish farming. Because of their fast growth and tolerance of high temperatures, rainbow trout (*Salmo gairdneri*) is the species most commonly used for fish farming. In general, trout farming can be described as follows: fingerlings are stocked in early spring soon after ice breakup and are allowed to grow through the summer, feeding on the abundant natural food in the water. During the growing season, fish can reach up to a pound (454 g) in size. In the fall or early winter, the trout are harvested. Any remaining fish generally perish in winter due to lack of oxygen, ensuring there are no larger trout to predate on trout fingerlings stocked the following spring.

Trout farming has become very popular in rural Manitoba where farmers may stock dugouts or gravel pits. Many of these people are "hobby farmers" -they stock private waterbodies to angle for their own enjoyment. More recently, there has been some interest in "U-catch-em" operations, where private individuals stock ponds with fish and then charge the public a fee for the fish they catch. Others raise fish for food to sell to local restaurants or grocery stores.

The technique of stocking free-roaming fish in small lakes, ponds, or dugouts is known as *extensive aquaculture*. The appeal of this activity is that there is no feeding required, costs are low, and no special skills are necessary. In some cases, if the pond is deep enough, or if the fish farmer aerates the water, fish can be overwintered.

Although trout farming appears simple in theory, many problems can be encountered. The purpose of this booklet is to provide a general guide to the trout farmer, and outline potential problems and their solutions.

The information in this booklet is based on the experience of Manitoba trout farmers, fisheries personnel in the Prairie Provinces, and the staff of the Freshwater Institute in Winnipeg, Manitoba.

For more information on fish farming or on Manitoba's fisheries in general, please feel free to visit our website at:

http://www.manitobafisheries.com

SELECTION OF SUITABLE LAKES

Lake selection is the first and most important step for a successful fish farming operation. The type of lake required depends on whether you want to raise trout for personal consumption, sale, or angling. The waterbody should be evaluated the summer and winter before stocking. Following are general criteria that should be considered when selecting or evaluating a waterbody for trout farming.

Type of Lake

A trout farming lake should be self-contained with no inlet or outlet. This prevents predaceous fish from entering stocked waters and newly stocked fingerlings from leaving the lake.

Predaceous fish, such as northern pike, walleye, or perch, will feed on trout fingerlings. To be sure these species are not present in the lake you wish to stock, set a gill net before planting your trout.

It is also advisable to avoid waters which contain minnows. These fish will compete with trout fingerlings for food. They may also carry parasites which may infest your trout and make them unmarketable.

Temperature

The best water temperature for trout ranges from 13°C to 18°C. Growth is reduced considerably at water temperatures above 21°C, and the trout will be stressed if the temperature remains above 24°C for extended periods of time.

A simple way to test the water temperature in your pond is as follows: attach capped glass or plastic bottles filled with pond water every few feet on a rope. Suspend them from a float anchored near the centre of the pond. Daily or weekly water temperatures measured in each bottle with an ordinary thermometer will provide a guide to average temperature at each depth. Measure the temperature in each bottle as it comes to the surface. Mid-afternoon is the best time since this is when daily temperatures are highest. Similar temperatures at surface and bottom usually indicate good circulation in the pond. However, if there is a significant difference between the surface and bottom temperatures (more than 3°C), the pond may be stratified and the water will not circulate properly. This can result in the depletion of oxygen in the deeper portions of the pond to levels too low for trout survival. As a general rule, pond temperature should remain below 22°C at one meter below the surface throughout the summer.

Oxygen

Trout survival and growth is dependent on a high level of dissolved oxygen in the water. During the summer, trout can survive dissolved oxygen levels as low as 3 parts per million (ppm) for a short period, but levels should remain above 5 ppm to ensure survival.

Lakes receive oxygen from wind or wave action on the surface and from aquatic plants which emit oxygen when growing in sunlight (photosynthesis). However, oxygen is used up by plant and animal respiration (breathing) and by organic decay. If more oxygen is being used than is being produced, oxygen levels will decline and may result in summerkill.

Winterkill

During the winter months, snow and ice effectively seal the lake from contact with the atmosphere and block sunlight, the preventing the two main oxygen-producing processes (wind and photosynthesis). However, respiration and decay continue, thereby reducing the existing oxygen level. Depending on a variety of factors, such as lake depth, fertility, snow cover, etc., the oxygen concentration may decline to a level where fish can no longer be supported, resulting in winterkill.

For the trout farmer interested only in personal consumption or sale, winterkill is desirable because it prevents those fish which escaped harvesting from overwintering. The advantage of this is twofold: it prevents these trout from feeding on the trout fingerlings stocked in the spring; and it allows the natural food supply (e.g. freshwater shrimp) to replenish their populations.

However, for those who wish to raise trout for angling, lakes which winterkill regularly should be avoided. Deep, infertile gravel pits are better suited for this type of operation.

The simplest test for winterkill is to drill a hole through the ice during late February or early March when oxygen will be at its lowest level. If the water smells like rotten eggs (hydrogen sulfide), it lacks oxygen. The lack of a rotten egg smell does not necessarily mean trout will overwinter. "User-friendly" dissolved oxygen test kits are available (see Appendix).

Water Quality

A trout lake should not be acidic (pH less than 7.0) or too alkaline (pH greater than 9.0). White chalky deposits along the shoreline is often characteristic of highly alkaline water. A general indication of suitable water is the presence of cattails and bulrushes along the shore.

Wind Exposure

The waterbody should be exposed to wind to ensure dissolved oxygen concentrations are maintained. Without circulation, the cool bottom waters become de-oxygenated due to decaying organic matter while the surface water becomes too warm and may result in summerkill. Wind-induced circulation allows the water layers to mix, thereby cooling the surface water and oxygenating the bottom water.

Aquatic Vegetation

Although algae and emergent vegetation are important sources of oxygen and are necessary for the growth of aquatic insects and crustaceans, ponds which exhibit excessive plant life should be avoided. Summerkills are common in ponds with heavy algae blooms and excessive growth of pond weeds makes trout harvesting difficult.

Lake Area

For recreational trout farming, a small lake (5 to 10 acres or 2 to 4 hectares) or even a farm dugout may be suitable. However, small waterbodies are more apt to summerkill than larger lakes. For commercial trout farming, consider larger lakes since they are more stable and less costly per hectare to harvest than several smaller lakes.

Lake Depth

A lake should be at least 5 feet (1.5 meters) deep and preferably 7 to 9 feet (2.1 to 2.4 meters) deep to ensure cooler water temperature during the summer. If survival over winter is desired, the pond should be deeper. However, depth will not guarantee survival, since winterkills have been reported in fertile ponds 25 feet (7.5 meters) deep.

Food Organisms

Fish food organisms must be present in a lake used for trout farming. Most success with trout farming has been in lakes and ponds with great numbers of freshwater shrimp (*Gammarus*), which are thought to give trout flesh a salmon-pink colour. Insect larvae are also a rich food supply for trout.

Dugouts and borrow pits should be old enough to have some rooted aquatic plants and shore vegetation, since these are necessary for the growth of aquatic insects and crustaceans.

Check for these organisms as the ice recedes from the shore during spring breakup. They may also be seen in holes cut in the ice in February and March. Running a sieve through the water aids in detecting the insect larvae and freshwater shrimp. If your waterbody contains these organisms, there is no need to feed the trout after they have been stocked. Although supplemental feeding with "trout pellets" may increase the growth slightly, most trout farmers find that artificial feeding is expensive in view of the results obtained.

FRESHWATER SHRIMP

AQUATIC INSECTS

OBTAINING AND STOCKING FINGERLINGS

Obtaining Fingerlings

The Department of Conservation does not supply fingerlings for private or commercial purposes. Fish must be bought from commercial sources, and fingerlings usually must be ordered several months before stocking time. Prospective fish farmers are encouraged to obtain fingerlings from Manitoba hatcheries, which are listed in the brochure "Manitoba Fish Farming Operations" available from any Fisheries office.

No person may import live fish into Manitoba without obtaining an Importation Permit from the local Fish Health Officer. This permit should be obtained at least two months prior to importation to allow time for Fisheries Branch to confirm the disease-free status of the hatchery. This regulation is strictly enforced to prevent the introduction of fish diseases into Manitoba. To obtain an Importation Permit, contact Shelley Matkowski, Local Fish Health Officer, Fisheries Branch, 200 Saulteaux Crescent, Winnipeg, Manitoba, R3J 3W3, phone: (204) 945-7789.

Fish farmers transporting fish within Manitoba require a Live Fish Handling Permit, unless they have purchased these fish from a Manitoba hatchery for the purpose of stocking their operations, in which case a receipt from the hatchery is sufficient. Live Fish Handling Permits may also be obtained from the local Fish Health Officer.

Size of Fingerlings to Stock

To grow trout to table size in the five to six month growing season, stock fingerlings 3 to 4.5 inches (7.5 to 10 cm) in length. Smaller fingerlings are less expensive but are less likely to reach a suitable size before harvest.

The size of fingerlings stocked depends on the type of operation planned. Trout farmers stocking large numbers of fingerlings will find 2.5 to 3 inch (6 to 7.5 cm) fingerlings to be the most economical size to purchase, while those stocking dugouts and borrow pits should use larger trout. If your objective is summer angling, you may have to stock 6 to 7 inch (12.5 to 15.4 cm) fish to allow them to grow to catchable size during the season. However, these larger trout are more expensive.

Stocking Rates

The number of trout stocked may influence the size and amount of trout produced. Stocking too many fingerlings may result in poor growth and high mortality. However, if too few fish are stocked, the pond will not be used to its full potential.

Because it is difficult to predict the suitability of a pond for trout farming, it is advisable to employ low stocking rates in the first year of operation (no more than 50 to 100 fingerlings per acre or 125 to 250 fingerlings per hectare). If the lake is successful, higher stocking rates can be used in succeeding years.

The optimum stocking rate varies between water bodies and is directly related to the pond's natural fertility. Stocking densities of 200 to 300 fingerlings per acre (500 to 750 fish per hectare) should produce satisfactory results for most ponds without depleting the natural food supply. Highly productive waters with abundant food may be capable of supporting higher stocking rates.

Dugouts, because of low fertility and available food should be stocked with no more than 200 to 300 trout per acre (500 to 750 trout per hectare). Stocking density should be calculated when the dugout is at its lowest summer level. For example, the standard farm dugout of 1/6 acres (0.07 hectares) or 60 by 120 feet (18 by 36 metres) should be able to support 50 to 100 fish.

Stocking Procedure

Stocking should occur within a week after spring breakup. This should allow sufficient time for the pond to replenish its oxygen content and will allow the fingerlings maximum use of the short growing season.

To avoid shocks resulting from changes in water temperature and water chemistry, the fingerlings should be acclimatized before being released into the pond. Place the containers holding the fingerlings in the pond until the temperature inside the container is within 2°C of the pond water temperature. This will take at least one-half hour. During the temperature equalization period, *gradually* mix in small quantities of pond water. This will help the trout to become acclimatized to the chemical features of the pond water.

After the fingerlings are acclimatized, release them well offshore and distribute them evenly around the lake. Trout fingerlings planted in the shallows may become entangled in plants or may be eaten by predaceous birds such as herons or gulls. If predators are a problem, plan to stock at dusk, giving the fingerlings all night to disperse.

Caging

Research conducted by the federal Freshwater Institute indicates there may be significant mortality of trout fingerlings soon after stocking. This mortality has been related to stress caused by factors such as starvation, crowding, transportation, water changes, and handling.

Stressed or weakened trout are susceptible to a variety of hazards which can result in mortality. Examples of these hazards are:

1. Weakened trout can become entangled in aquatic vegetation;

2. Dytiscid beetles (large, black, hard-shelled water beetles) can catch and kill weak fingerlings;

3. Stressed fingerlings may sink to the bottom of the pond into a toxic layer of hydrogen sulfide (or region of low oxygen) and perish. Experiments show that trout under stress from transportation shock cannot distinguish good water from toxic water; and

4. Since hatchery trout are accustomed to being fed at the surface, they initially tend to congregate there in search of food. This leaves them vulnerable to predation by birds.

These problems can be eliminated by holding the fingerlings in cages for two or three weeks. During this time, the fingerlings can recover from stress, become acclimatized to their new environment, and begin to feed on the natural food supply.

The appropriate stocking density for caged fingerlings is approximately 2 pounds of fingerlings per cubic foot of cage volume. Fingerlings caged at this density can be held for up to three weeks with no ill effects.

Cages should be constructed of a wood frame with plastic or nylon mesh. These materials are non-toxic, non-corrosive, and light weight. The top of the cage should be plywood to shelter the fingerlings from the sun and provide a haven for the aquatic organisms on which they feed. The cages should float at or near the surface, but be anchored to the bottom by a weight and rope of appropriate length. This will prevent the cage from being "washed" onto shore. It is *critical* that the cage does not come in contact with the bottom of the pond where the possibility of zero oxygen and toxic water may exist.

PROBLEMS IN TROUT FARMING

Summerkill

The main problem experienced by rainbow trout farmers during the summer months is partial or complete die-off or summerkill of their trout. The most common cause of summerkill is the dense growth, then sudden collapse, of blooms of filamentous blue-green algae (*Aphanizomenon sp.*). This algae resembles small grass clippings suspended throughout the water. Algae blooms are most severe from mid-July to mid-September. Eventually the algae will exhaust its nutrient supply in the water and a massive "die-off" of algae will occur. The dead algae will settle on the bottom where it is decomposed (oxidized) by bacteria. During this process, the water's oxygen supply may be exhausted, causing the trout to suffocate.

Algae Control

Although algicide may provide a short-term solution to algae problems, the best way to control algae is to limit the introduction of nutrients into the pond.

This can be done by preventing nutrient-rich water carrying manure or fertilizer from entering the pond. Cattle should not have access to the pond. Also, a fringe of reduced vegetation cover, at least 100 feet (30 meters) in width should be maintained around the pond to act as a buffer or nutrient filter. Stabilizing the shoreline with rocks and gravel will also act as a natural filter and will prevent soil erosion from wave action.

If, however, chemical treatment is necessary, copper sulfate (bluestone) is recommended. This chemical should be available from your local hardware store or farm supply operation. Treat early in the season before the algae has reached "bloom" proportions. Fill a clean quart sealer with pond water and hold it up to the light. When water temperatures reach 18°C, the "grass clipping" algae starts to grow as 1/8 inch long, hairlike, green filaments suspended in the water from top to bottom. The filaments begin to lengthen, thicken, and increase in number and resemble small grass clippings suspended in the water. At this stage, the filaments will be approximately 1/2 inch (1.3 cm) long. Treat the surface of your pond evenly at a rate of 1 - 1 1/2 pounds per acre (1.12 - 1.68 kg per ha) in ponds 8 to 10 feet (2.4 to 3 m) deep or 2 pounds per acre (2.25 kg per ha) in ponds 10 to 12 feet (3 to 3.6 m) deep. CAUTION: These concentrations should not be exceeded. Although copper sulfate is probably the best and cheapest "all-round" algicide, it can be toxic to trout and food organisms at higher concentrations. The copper sulfate may be dissolved in water and applied to the pond's surface as a spray or placed in a fine mesh bag (e.g. flour or alfalfa sack) and dragged through the water until it has dissolved. Water temperature should be 15°C or higher for the chemical to be effective. Treatment on a windy day provides for better mixing.

If the algae has reached "bloom" proportions, measuring 1/2 to 5/8 inch (1.3 to 1.6 cm) long and has clumped together in small pea-sized clusters to walnut-sized lumps, it is *too late* for a general overall treatment of the pond. Treating the pond during the bloom stage could precipitate a summerkill rather than prevent one. "Spot" treatments applied to 1/4 of the pond over three to four day intervals may gradually lower the algae density without artificially inducing a total algae die-off.

However, the safest approach is to refrain from chemically treating the pond when bloom has occurred. An alternative which may alleviate low oxygen levels in the water is to aerate the water vigorously by spraying or bubbling. An irrigation pump can be used to draw water from one end of the pond (near the surface) and release it as a fountain at the opposite end.

Water bodies on Crown land or with outlets require a permit from the Clean Environment Commission before algicides are applied. Permits are *not* required for self-contained water bodies on private land.

Predation

Various birds (gulls, loons, pelicans, cormorants, mergansers, kingfishers, herons, bitterns, and terns) and animals (mink, raccoons) have been known to prey on stocked trout fingerlings. Because it is illegal to kill many of these animals, only deterrent methods that do not directly harm the predator can be used to discourage them. Trout are most vulnerable to predation when first stocked in the spring, so try to keep a close watch on the pond then and frighten away any predator you see. As previously mentioned, using of cages or stocking at dusk should reduce the chances of predation.

Muddy Flavour

Trout from some ponds develop an unpleasant muddy flavour during the summer, but this problem may clear up naturally as the water cools in autumn. Taste-test a small sample of trout before you begin harvesting. If you detect a muddy flavour, delay the harvest until later in the fall or winter (see Winter Fishing). The longer the fish remain in the cold water, the less likely the problem is to persist.

Springkill

In deeper ponds where fish may be overwintered, the problem of "springkill" may occasionally arise. The fish farmer may find that the fish have survived the winter, only to die off shortly after the ice has gone off the pond. Over the winter, as wastes from the fish build up and vegetation decomposes, the bottom layer of the pond builds up toxic hydrogen sulfide and ammonia levels, and oxygen levels decline. When the ice first leaves the pond in the spring, the first major wind that turns over and mixes the pond water stirs the toxic, oxygen-depleted water up from the bottom and distributes it throughout the pond. The volume of the lower toxic layer may be sufficient to "poison" the entire pond when turned over by the wind.

Aeration to Prevent Winterkill and Springkill

Oxygen depletion commonly occurs during the winter season in ponds and dugouts. After ice forms in the fall, snow and ice prevent diffusion of oxygen from the air, and light penetration is reduced, which in turn reduces photosynthetic activity of aquatic plants in the pond. Decomposition of organic matter in the pond utilizes all of the available oxygen causing the fish to suffocate. A winterkill occurs.

Winter oxygen levels in ponds can be improved by aerating the pond, i.e. adding oxygen or air by artificial means. Maintaining oxygen levels throughout the winter will also prevent "springkill".

The most common method of aeration is the diffused air system. A compressor or blower forces air through a perforated or porous plastic pipe near the pond bottom, and oxygen is transferred from the rising bubbles to the water. Best oxygen transfer is achieved with a small bubble size. This is a fairly efficient aeration system, but problems may be encountered with clogging of the holes in the pipe if the system is not used for long periods. This problem can usually be avoided by suspending the pipes about 30 cm above the pond bottom.

Compressors used should be of the oilless type, or oil coating the bubbles will lessen the diffusion of oxygen to the water. A check valve should be installed to prevent water from backing up and freezing the line in winter.

Spray type aerators work by propelling water upwards against a cone or through slots in a tube. The water forms a find spray which absorbs oxygen, and some mixing of the pond occurs. These units can be mounted on floats and are easily moved when not in use. Spray-type aerators cannot raise dissolved oxygen levels quickly in large ponds, but are useful when regular aeration is required to maintain suitable oxygen concentrations in smaller ponds. These units are the most efficient in terms of oxygen transferred for energy consumed and are ideal for use on dugouts less than 0.2 hectares in size. This type of aerator is useful for both summer and winter aeration.

When electrical power must be supplied to an aerator, a ground fault interrupt (GFI) breaker should be used. These breakers will trip if there is an electrical leak from the line and are essential for a safe aeration system. Always disconnect the power supply to an aerator before doing any work on the water.

Windmill-type aerators have paddles which stir the water surface to mix in air and circulate water throughout the pond. A constant wind is required for their operation, although some come with generators to permit their use when there is no wind. When used in winter, problems may arise with ice forming on the paddles when the weather is calm.

Continuous aeration is not usually necessary to overwinter fish. Aeration for six to eight hours twice per week is usually sufficient in dugouts; larger ponds will obviously require more aeration. Weekly monitoring of oxygen levels during the winter will help determine the frequency and length of aeration needed to maintain acceptable oxygen levels in your pond. Electronic testing equipment is available but chemical methods are less expensive and generally adequate for most use. Sources for water testing equipment are listed at the back of this brochure.

TROUT HARVESTING

Harvesting is expensive and requires time, effort, equipment, and know-how. Be well-organized, with all equipment in good repair, and make arrangements for extra help, if needed.

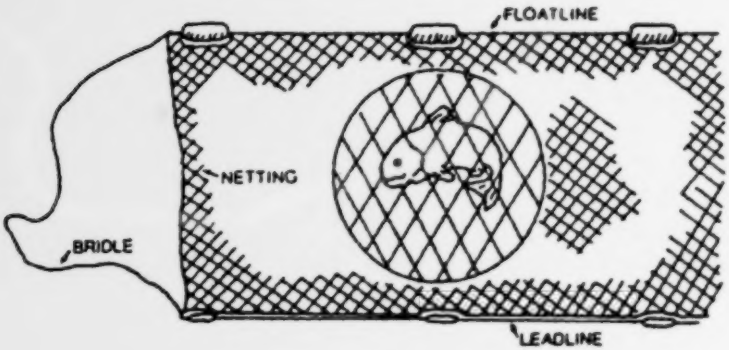
When to Harvest

Trout should be harvested in the late fall or early winter to ensure the best growth and flesh quality. For open water netting, the latter part of October is recommended. If left too late, however, harvesting may be hampered by freezing equipment or ice on the pond's surface. It is not uncommon for nets to freeze in overnight. For information on harvesting after freeze-up, refer to the section on Winter Fishing.

Harvesting with Gill Nets

The most common method of harvesting trout is with gill nets. (See Appendix for list of suppliers.) When ordering nets, specify mesh size, thread size, length, and depth. Nets can be ordered with either individual lead weights or a lead core "lake" leadline. Leadline is more expensive, but it makes the net easier to handle. Net suppliers may require several months notice as they may have to order materials to make up the nets. Nets should therefore be ordered in summer.

A gill net catches fish by mesh thread catching behind the gill cover as fish try to swim through the mesh. Mesh size should allow only the fish's head through. The most commonly used mesh sizes are 2 1/2 inch (6.4 cm), 2 3/4 inch (7.0 cm), and 3 inch (7.6 cm), with a thread size of 210/3. Since trout vary in size, and growth may not be the same each year or in each lake, larger or smaller nets may be more effective on a particular lake. The best mesh size is primarily determined by trial and error.



Nets of 50 yards (46 m) or less are the best length for most winterkill lakes. The inexperienced fisherman will find shorter nets easier to handle, and nets can be tied together if a larger net is required. Longer nets may be more effective on larger lakes.

Net depth should be between 5 feet (1.5 m) and 10 feet (3 m), depending on depth of the pond. Do not use a net that is significantly deeper than that part of the pond being fished.

Intensive commercial harvesting requires an adequate number of nets. For lakes 10 to 25 acres (4 to 10 ha) in size, set 30 years of net per acre (68 m of net per ha), for lakes 25 to 50 acres (10 to 20 ha) in size, set 20 yards of net per acre (45 m of net per ha), and for larger lakes, 10 years of net per acre (23 m of net per ha) will be about all you can handle. More or fewer nets may be needed depending on the number of people fishing and how quickly you want to complete the harvest. Two inexperienced people fishing a large lake can likely manage only 300 to 500 yards (275 to 460 m) of net.

A boat and small outboard motor are needed if your lake is much larger than 25 acres (10 ha). Life jackets should always be worn when working from a boat and common sense safety rules should be observed. (See "Water Safety" in Appendix.)

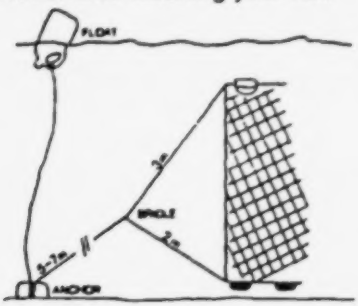
Setting Gill Nets

The most common problem when setting gill nets is keeping the mesh and lines from becoming tangled. This can be avoided if the nets are properly packed. Before you go out on the lake, box the nets by holding the floatline and leadline together, free from the mesh, and then gather the mesh to the lines while coiling the net into a tub or box. A large plastic tub with handles is ideal. Leave the bridle at one end of the net on top of the coiled net where it can be easily found. Holes should be drilled in the bottom corners of the tub for excess water to drain out.

The most productive nets are those set in the late afternoon and lifted early the following morning. Trout tend to avoid nets during daylight hours, especially in clear water.

The simplest and most productive way to set a net is out from the shore towards the centre of the lake. Setting the net downwind will prevent the boat from being blown back over the net. It is best for two people to work together; one to handle the motor or oars, and the other to set the nets. Tie the bridle to a tree or stake on shore and "play" the net out of the tub. Tie the end bridle and buoy line to the anchor line and pull any extra slack out of the net before anchoring. Gallon plastic jugs make good marking buoys. Anchor with a rock or jug filled with sand.

If a net does not catch many fish, move it to another part of the lake and experiment with different sets, closer or further from shore. Do not set nets in dense patches of submerged vegetation or you will spend a lot of time cleaning your net.



Lifting Gill Nets

Nets should be lifted daily (early morning) and preferably twice daily to avoid losses due to drowned fish. "Lift" or "run" a net from the bow of the boat, moving into the wind. If the net is to be moved, it should be pulled into the boat and the trout removed in the process. If the net is to be left in the same location, simply pull the net across the bow or along the side without lifting the anchor. Take the trout from the mesh and let the net fall back into the water.

Because trout flesh is easily damaged, handle the fish carefully when removing them from the net. **Do not force** trout through the net's mesh. If they will not pull through easily, "back them out" after freeing their gill covers from the net strands. Pack the fish in ice as soon as they are removed from the net.

Three or four days of fishing with an adequate number of nets will usually capture most of the trout in a small lake. Harvest will be extended considerably if you are fishing a large lake or using fewer nets. Is your catch drops off, leave the lake for several days and then resume fishing. Catches may improve.

Net Maintenance

Nets are a major expense but with proper care they will last many years. After each use, the nets should be hosed down and hung to dry. **Do not dry nets in direct sunlight** as this will cause shrinkage and weakening of the net fibres.

Winter Fishing

Winter harvesting should begin in November or December when there is sufficient ice to safely walk on (4 to 6 inches or 10 to 12.5 cm). Some productive ponds may winterkill as early as December, limiting winter fishing to three to four weeks.

Two people using an ice jigger (available from most gill net suppliers) are required to set a gill net under the ice. The jigger is lowered into the water through a hole cut in the ice. The jigger is buoyant and floats to the underside of the ice. One person then propels the jigger forward by pulling and releasing the running line. This jerking action causes the jigger to pull itself along the ice. The second person follows its movements by either listening to the tapping sound it makes each time the running line is pulled or just watching it if there is no snow cover and it can actually be seen under the ice. After the jigger has been sent out the desired distance, you must cut another hole through the ice to remove the jigger. Then use the running line to haul a length of net between the two holes. The net should be weighted at both ends and set deep enough to prevent the floats from freezing to the ice. Tie both ends of the net to sticks placed across the holes in the ice.

Other Methods of Harvesting

Seine nets are effective in small dugouts with a uniform bottom, but are expensive. The net is simply pulled through the water, gathering the trout alive. Net suppliers will make up seines to any depth and width.

Angling is obviously the harvesting method of choice for fish farmers who have simply stocked fish for their own recreational enjoyment or for those with "U-catch-em" operations. Fly fishing, light spinning tackle, or natural bait are preferred for ponds and small lakes.

Recovery and Growth Rates to be Expected

Both recovery and growth rate depend on a variety of factors, including stocking rate, size and condition of the fingerlings, weather conditions, lake morphometry and fertility, etc. Recovery rates from 0 to over 80% have been reported, but most farms recover 20% to 40% of their stock. Growth is also highly variable in prairie ponds, but 2 to 3 inch (5.1 to 7.6 cm) trout fingerlings stocked in the spring can attain a weight of 10 to 12 ounces (284 to 340 g) by fall, while 3 to 4 inch (7.6 to 10.2 cm) fingerlings may reach one pound (454 g) or more by harvest time.

DRESSING AND PROCESSING TROUT

Dressing

Trout is a highly perishable food product and therefore should be dressed as soon as possible after removal from the net. A delay in dressing will cause rib separation, flesh discolouration, and softening of whole trout even when they are well-iced.

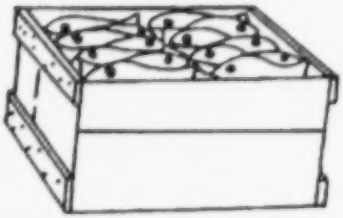
The dressing site must be maintained in a sanitary condition. All equipment must be kept clean and protected against weather and insects. Do not spray processing facilities with insecticide as this will contaminate the trout.

With a sharp knife and spoon, trout can be dressed as follows (see diagram). First, cut through the forward throat region just behind where the gills attach under the mouth (#1) and run the blade between the gill covers and body (#2) to cut through the esophagus. Then lift one gill cover and cut the gills loose from their upper attachment near the backbone (#3) and pull the gills from their cavity with the point of the knife. Gills can be easily torn loose from their bottom attachment. Next, cut a straight line (#4) up the belly to the vent, taking care not to cut the flesh behind the vent.

Pull out the guts and clean out the kidney along the backbone by carefully cutting the covering membrane with your knife and scraping the kidney out with your spoon. **Make sure** all guts and gills are removed and rinse out any blood with clean water.

Packing the Trout

Place 2 or 3 inches (5 to 7.6 cm) of finely crushed clean ice in the bottom of the packing box. Hand pack the dressed fish belly down, three layers deep, with a thin layer of crushed ice between each layer. Cover the top layer with ice level with the top of the box (see illustration).



Preserving and Preparing Trout

For everything you've ever wanted to know about freezing, canning, smoking, or cooking freshwater fish, we recommend you obtain "A Guide to Handling and Preparing Freshwater Fish" by D.G. Iredale and R.K. York. This publication may be obtained from the Freshwater Institute, Publications Department, 501 University Crescent, Winnipeg, Manitoba (phone: 983-5108). A second brochure, "The 'How-To' Book of Fish and Seafood" is also available from the Freshwater Institute.

PROVINCIAL REQUIREMENTS FOR FISH FARMING

Fish Farming Licence - $15.00 Fee

A Fish Farming Licence is required for a commercial operation or for fish farming in water bodies surrounded by Crown land. The licence is valid from April 1st to the following March 31st, and is issued from the regional Department of Conservation office closest to the water body. A Fish Farming Licence grants the holder rights for any of the following types of operations:

- To stock and harvest fish for commercial market sale. The fish may be sold directly to local consumers, or to wholesalers, retailers, and restaurants, providing the fish have been processed in a manner approved by a Health Inspector.

- To stock fish in a water body for sale to the public by means of angling, commonly known as a "U-catch-'em" or "fee for fishing" pond. People angling at such an establishment do not require a provincial angling licence, but must retain a receipt showing the source of the fish for their own protection.

- To act as a broker, importing live fish from suppliers outside the province and reselling them in smaller lots to private or commercial fish farmers in Manitoba.

Generally, licences are issued only for self-contained water bodies (without inlets or outlets) surrounded by private lands. However, the use of lakes bordered by Crown lands will be considered on a case-by-case basis by the Regional Fisheries Manager responsible for those water bodies. It should be noted that licences will not be issued for water bodies located within natural brook trout watersheds in the Northeast Region of Manitoba. Regional Manitoba Conservation offices are listed in the Appendix.

Licences may also be issued from Fisheries Branch in Winnipeg, which will communicate with the Regional Fisheries Manager for the necessary approval. For further information, contact::

Barbara Scaife
Manitoba Fisheries Branch
Box 20 - 200 Saulteaux Crescent
Winnipeg, Manitoba
R3J 3W3
Phone: (204) 945-0559
E-mail: bscaife@gov.mb.ca

If water is diverted from its normal course, impounded or discharged into another water body, you may require additional licences or permits from Manitoba Conservation, or the municipality in which you live. Contact the regional Manitoba Conservation office in which your lake or pond is located for additional information regarding these licences.

Fish farmers wishing to sell their fish directly to the consumer, to restaurants, or to retail stores within the province should have their operation inspected by a Provincial Health Inspector. For further information, contact:

Manitoba Conservation
Inspection Services
Union Station Building, 123 Main Street
Winnipeg, Manitoba
R3C 1A5
Phone: (204) 945-7049

In addition, fish farmers wishing to sell their product door-to-door in Winnipeg will require a Hawker's Licence, available from:

City of Winnipeg Licence Branch
457 Main Street
Winnipeg, Manitoba
R3B 1B5
Phone: (204) 986-6421

The Licence Branch will refer the application to the City Health Department which will require a City of Winnipeg Public Health Inspector to check the vehicle used for distribution to ensure it has adequate refrigeration, etc. The Public Health Inspector will also contact the Provincial Health Inspector to ensure the fish farming facility meets provincial health standards.

As stated above, a Fish Farming Licence allows the operator to sell directly to local consumers, retailers, restaurants, etc. While certain fish species may also require a Special Dealer's Licence issued by the Freshwater Fish Marketing Corporation (FFMC) under the Freshwater Fish Marketing Act, commonly farmed species such as rainbow trout are exempt.

APPENDIX

General Information

Provincial Government

Fish Farming, Fisheries Branch, Manitoba Department of Conservation, Box 20, 200 Saulteaux Crescent, Winnipeg, Manitoba, R3J 3W3. Phone: (204) 945-0559.

Federal Government

Department of Fisheries and Oceans, Freshwater Institute, 501 University Crescent, Winnipeg, Manitoba, R3T 2N6. Phone: (204) 983-5000.

Office for the Commissioner of Aquaculture Development, 344 Slater Street, Suite 1610, Ottawa, Ontario, K1A 0E6. Phone: (613) 993-8603. Fax: (613) 993-8607.

Manitoba Conservation Regional Offices

Western Region: (Brandon office), 1129 Queens Avenue, Brandon, Manitoba,R7A 1L9. Phone: (204) 726-6449. (Dauphin office), Provincial Building, Box 10, 27 2nd Avenue S.W., Dauphin, Manitoba, R7N 3E5. Phone: (204) 622-2205.

Eastern/Southeastern Region, Box 4000, Lac du Bonnet, Manitoba, R0E 1A0. Phone: (204) 345-1450.

Interlake Region, Box 6000, Gimli Industrial Park, Gimli, Manitoba, R0C 1B0. Phone: (204) 642-6072.

Northwestern Region, Provincial Building, Box 2550, 3rd & Ross Avenue, The Pas, Manitoba, R9A 1M4. Phone: (204) 627-8296.

Northeastern Region, Provincial Building, Box 28, 59 Elizabeth Drive, Thompson, Manitoba, R8N 1X4. Phone: (204) 677-6650.

Regulations and Licensing

Fish Farming Licence:

Barbara Scaife. Fisheries Branch, Manitoba Department of Conservation, Box 20, 200 Saulteaux Crescent, Winnipeg, Manitoba, R3J 3W3. Phone: (204) 945-0559.
E-mail: bscaife@gov.mb.ca

Fish Importation Permit, Live Fish Handling Permit:

Shelley Matkowski. Fisheries Branch, Manitoba Department of Conservation, Box 20, 200 Saulteaux Crescent, Winnipeg, Manitoba, R3J 3W3. Phone: (204) 945-7789.
E-mail: smatkowski@gov.mb.ca

Water Rights Licence:

Manitoba Water Resources Branch, Water Licensing Section, 200 Saulteaux Crescent, Winnipeg, Manitoba, R3J 3W3. Phone: (204) 945-6475.

Environmental Licence:

Manitoba Department of Conservation, Environmental Approvals, Union Station Building, 123 Main Street, Winnipeg, Manitoba, R3C 1A5. Phone: (204) 945-7071.

Fish Suppliers

The brochure "Manitoba Fish Farming Operations" which lists suppliers and the species and size of fish they sell is available from:

Fisheries Branch, Manitoba Department of Conservation, Box 20, 200 Saulteaux Crescent, Winnipeg, Manitoba, R3J 3W3. Phone: (204) 945-0559. E-mail: bscaife@gov.mb.ca

Fish Food Suppliers

Most fish suppliers also sell food. In addition, you may contact:

Feed-Rite Ltd., 17 Speers Road, Winnipeg, Manitoba, R2J 1M1.
Phone: (204) 233-8418.

Martin Feed Mills, 2 Arthur Street, Elmira, Ontario, N3B 3A2.
Phone: (519) 669-5171.

Park City Products, 360 Dawson Road, Winnipeg, Manitoba,
R2J 0S7. Phone: (204) 233-0230. Fax: (204) 235-1860.
1-800-665-8854.

Net Suppliers

Clear Springs Aqua Farms, P.O. Box 1239, Roblin, Manitoba,
R0L 1P0. Phone: (204) 937-4403 or (204) 937-8087.

Leckie's - Division of Lakefish Net & Twine Ltd.,
547 King Edward Street, Winnipeg, Manitoba, R3H 0N9.
Phone: (204) 774-1887.

Water Testing Apparatus

Aquatic Life Ltd. 41-360 Keewatin Street, Winnipeg, Manitoba
R2X 2Y3. Phone: (204) 697-3634. Fax: (204) 697-3419.
E-mail: aquatic@aquaticlife.ca
Website: http://www.aquaticlife.ca

Fisher Scientific Limited, 1137 Keewatin Street, Winnipeg,
Manitoba, R2X 2Z3. Sales: (204) 944-9769 or
1-800-661-9981.

Water Testing Apparatus (cont'd)

For a complete analysis of your pond water, you can submit a 2-litre sample to:

Enviro-Test Laboratories
745 Logan Avenue, Winnipeg, Manitoba, R3E 3L5.
Phone: (204) 945-3705.

Aerators

Wil Rex, Rex Ranch Supply, Box 129, Holland, Manitoba R0G 0X0. Phone: (204) 526-2194 or 526-7669. Fax: (204) 526-2381.

Koenders Windmills Inc. Box 126, Engelfield, Saskatchewan. Phone: (306) 287-3702. Fax: (306) 287-3657.

Aquaculture Organizations

To obtain firsthand information on setting up an aquaculture business in Manitoba, contact:

Mr. Peter Palaschuk, Manitoba Aquaculture Producers Association, c/o Arctic Aquafarms, Box 51, Garson, Manitoba, R0E 0R0. Phone: (204) 268-3327. Fax: (204) 268-3726.

Aquaculture Association of Canada, 16 Lobster Lane, St. Andrews, New Brunswick, E5B 3T6. Phone: (506) 529-4766. Fax: (506) 529-4609. Website: http://www.ifmt.nf.ca/mi/aac/ac.htm
Membership includes a year's subscription to Northern Aquaculture Magazine, the AAC Bulletin, and World Aquaculture Magazine.

SUGGESTED REFERENCES

Books

Ontario Ministry of Natural Resources. 1984. Handbook of Fish Culture.

McLarney, William. 1984. The Freshwater Aquaculture Book. A Handbook for small scale fish culture in North America. Hartley & Marks, Ltd. Vancouver, B.C. 583 p.

Pamphlets

Ontario Ministry of Natural Resources. 1986. Aquaculture in Ontario. 80 p.

Saskatchewan Parks, Recreation and Culture. Fisheries Branch. 1988. Aquaculture in Saskatchewan - Dugouts and Ponds. 4th Revision. 20 p.

Magazines

Aquaculture Magazine, Subscription Department, P.O. Box 2329, Asheville, N.C. U.S.A. 28802. Phone: (828) 254-7334. Fax: (828) 253-0677. E-mail: aquamag@ioa.com Website: http://www.aquaculturemag.com

Fish Farm News, Site 114, Unit 3, C-22, R.R.1, Campbell River, B.C.V9W 3S4.

Northern Aquaculture, Subscription Services, RR#4 Site 465 C-37, Courtenay, B.C. V9N 7J3. Phone: (250) 338-2455. Fax: (250) 338-2466. NAQUA Online: http:/www.naqua.com

Salmonid, (formerly Journal of the U.S. Trout Farmers Association), P.O. Box 220, Harpers Ferry, West Virginia, U.S.A. 25425.

WATER SAFETY

Water safety is primarily just good sense. The points below are helpful guidelines:

1. Always wear your life jacket.

2. If you can't swim, don't go out in a boat alone.

3. Never leave a running boat motor unattended.

4. Keep the floor of the boat clear. Put nets and fish in tubs, not loose on the floor of the boat. Keep knives sheathed when not in use. Store ropes and anchor stones under the seats or out of the way.

5. Keep the boat in good repair. Always carry oars or paddles in a motor boat.

6. Don't wear chest waders when working in deep, weedy water.

7. Don't go out on a rough lake or during a lightning storm.

8. Don't overload the boat.

9. If winter fishing, make certain there is at least 4 inches (10.2 cm) of solid ice before walking on the ice; light vehicles require 7 to 8 inches (17.8 cm to 20.3 cm) of solid ice.

BE CAREFUL!

NOTE: Canadian Coast Guard's new boating safety initiative is phasing in requirements for boat operators to carry operator competency certification. Also, there are rules about the minimum required safety equipment that you must have on board. For more information, contact the Boating Safety Hotline at: 1-800-267-6687.

April, 2003